The Role of AI, Machine Learning, and Big Data in Digital Twinning: A Systematic Literature Review, Challenges, and Opportunities

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Abstract

Digital twinning is one of the top ten technology trends in the last couple of years, due to its high applicability in the industrial sector. The integration of big data analytics and artificial intelligence/machine learning (AI-ML) techniques with digital twinning, further enriches its significance and research potential with new opportunities and unique challenges. To date, a number of scientific models have been designed and implemented related to this evolving topic. However, there is no systematic review of digital twinning, particularly focusing on the role of AI-ML and big data, to guide the academia and industry towards future developments. Therefore, this article emphasizes the role of big data and AI-ML in the creation of digital twins (DTs) or DT-based systems for various industrial applications, by highlighting the current state-of-the-art deployments. We performed a systematic review on top of multidisciplinary electronic bibliographic databases, in addition to existing patents in the field. Also, we identified development-tools that can facilitate various levels of the digital twinning. Further, we designed a big data driven and AI-enriched reference architecture that leads developers to a complete DT-enabled system. Finally, we highlighted the research potential of AI-ML for digital twinning by unveiling challenges and current opportunities.